Thomas Fire 2017-2018, Los Padres National Forest
BAER Hydrology Report

Resource Specialty: Hydrology
Fire Name: Thomas Fires
Month and Year: December 2017-January 2018
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Objectives

This assessment focused on evaluating possible post-fire hydrologic threats to potential values at risk for the Thomas Fire on the Los Padres National Forest, Santa Barbara County, California. Hydrologic post-fire threats include post-fire flooding, slope instability, and bulking of flows from sediment and debris. Potential threats also include avulsion on depositional fans and catchment outlets due to bulked flows (rapid relocation of channel location); braiding of channels, scour, and channel migration.

I. Potential Values at Risk

Initial potential Values at Risk (VARs) identified for evaluation for the Thomas Fire are listed below. See VAR spreadsheet in the 2500-8 for detailed list of evaluated values at risk (VARs). During preliminary reconnaissance, it was recognized that whole communities, major highways and roads, and privately owned infrastructure downstream/slope of the Thomas Fire could be affected by post-fire effects. A State Watershed Emergency Response Team (WERT) was tasked with conducting an assessment of VARs on non-FS lands including all these areas. This BAER assessment focuses on VARs owned by the Forest Service or located on FS lands. An initial BAER assessment considered VARs in the Ojai and Wheeler Ridge areas so these areas are excluded from this report. This assessment does not include assessment of post-fire impacts within the Adams Canyon, Harmon Canyon, Arundell Barranca, or Lower Ventura River HUC 6 watersheds. These HUC 6 watersheds lack FS lands within the watershed boundary.

Potential VARs identified for evaluation included:

Non-FS owned lands and infrastructure and associated life and safety
- Private residences and communities on non-FS lands (inholdings and adjacent lands)
- Infrastructure and associated life and safety:
  - highways, roads, trails, bridges, etc
  - reservoirs and dams
  - municipal water sources

FS owned lands
- Dispersed recreation (trails and backcountry primitive campsites)
- Developed recreation (trails and developed campgrounds)
- Forest Service facilities (administration buildings, fire stations)
- FS roads and stream crossings

- Natural resources (hydrologic function and processes, water quality for beneficial uses)
- Heritage sites

II. Resource Condition Assessment

A. Resource Setting –

The Thomas Fire started on December 4th, 2017 and burned approximately 281,893 acres along the Santa Ynez Mountain Range, within the Ojai and Santa Barbara Ranger Districts and surrounding lands, California. The fire area extends from Ventura at the south to Potrero Seco in the north and Cold Springs Canyon area in the west to Sespe Creek in the east. The fire burned through areas with dense to sparse chaparral community brushlands, oak, riparian vegetation, grasslands and through communities. In general, the most recent sizable fire history includes Grand 1996, Steckel 1994, Wheeler 1985, Creek Road 1977, and Romero 1971 fires. Most of the Thomas Fire area has not burned since the 90s and mid-80s resulting in the development of mature brush communities and duff accumulation.

This report groups the burn area into 7 different areas for consistency in reporting post fire impacts in the geology, soils, and hydrology BAER reports.

- Pacific Frontal includes the ocean draining catchments from Mission Creek to Lower Ventura (Mission, Santa Monica, Carpinteria, Rincon, Los Sauces, and Lower Ventura creeks).
- Santa Ynez River including Juncal Canyon, Agua Caliente Canyon, and Blue Canyon areas.
- Matilija Canyon
- North Fork Matilija
- Coyote Creek and surrounding catchments draining to Lake Casitas
- Santa Paula Creek
- Sespe Creek and tributaries.

General Information:

Watershed resources located within and downstream of the burn areas include springs, perennial, intermittent and ephemeral streams, and reservoirs. The fire lies within 25 HUC 6 level watersheds, see Table 1 for acres and percent moderate and high soil burn severity (SBS). Main waterbodies within and downstream of the burn area include: Lake Casitas, Jameson Reservoir, Gibraltar Reservoir, Matilija Lake, and Lake Cachuma. Main drainage systems include the Santa Ynez River system, Ventura River system, and Santa Clara River system. Multiple smaller drainage systems comprise the coastal watersheds in the Pacific Frontal area. Table 2 lists the miles of stream channel within the fire burn perimeter.

Table 1: List of HUC 6 watersheds within the Thomas Fire and acres of SBS.

HUC 6 12 digit ID	HUC 6 Watershed Name	Acres	Unburned	Low	Moderate	High	Acres Burned at Moderate and High SBS within watershed
180701020701	Abadi Creek-Sespe Creek	29,702	5,679	2,568	1,502	35	5%
180701020903	Adams Canyon-Santa Clara River	36,655	2,996	12,222	8,230	2	22%
180600100201	Agua Caliente Canyon	21,599	242	445	735	6	3%
180701010203	Arundell Barranca-Frontal Pacific Ocean	19,024	800	4,335	2,685	11	14%
180600100203	Blue Canyon-Santa Ynez River	10,081	155	297	940	2	9%
180701020706	Boulder Creek-Sespe Creek	22,520	2308	4,015	3,449	0	15%
180600130204	Carpinteria Creek	11,272	49	1,350	6,674	48	60%
180701010105	Coyote Creek	26,437	1,156	7,380	12,414	217	48%
180600100401	Gibraltar Reservoir-Santa Ynez River	32,186	2	2	0		0%
180701020904	Harmon Canyon-Santa Clara River	24,914	902	3,790	1,028		4%
180600100202	Juncal Canyon-Santa Ynez River	18,280	273	1,625	15,098	214	84%
180701010202	Los Sauces Creek-Frontal Pacific Ocean	41,854	902	3,782	5,986	363	15%
180701010106	Lower Ventura River	26,183	923	1,419	1,510	3	6%
180701010101	Matilija Creek	34,931	2,688	4,739	26,735	754	79%
180600130203	Mission Creek-Frontal Santa Barbara Channel	69,931	536	1,585	5,310	49	8%
180701010102	North Fork Matilija Creek	10,287	448	1,962	7,764	47	76%
180701020703	Piedra Blanca Creek-Sespe Creek	37,079	268	317	318	0	1%
180701010201	Rincon Creek	9,357	501	2,505	4,799	11	51%
180701010103	San Antonio Creek	32,750	6,746	7,997	10,618	57	33%
180600130205	Santa Monica Creek-Frontal Santa Barbara Channel	27,721	99	1,140	3,511	13	13%
180701020901	Santa Paula Creek	29,014	2,914	6,965	14,182	640	51%
180701020902	Timber Canyon-Santa Clara River	23,334	732	2,749	3,155	2	14%
180701020702	Tule Creek-Sespe Creek	31,513	1,573	2,975	9,067	249	30%
180701010104	Upper Ventura River	13,807	2,049	2,135	1,785	0	13%
180701020705	West Fork Sespe Creek-Sespe Creek	40,017	161	258	631		2%
180701020701	Abadi Creek-Sespe Creek	29,702	5,679	2,568	1,502	35	5%
180701020903	Adams Canyon-Santa Clara River	36,655	2,996	12,222	8,230	2	22%

Table 2: Miles of stream channel and type within the Thomas Fire perimeter.

Type of Stream	Perennial	Intermittent	Ephemeral
Stream Miles	128	1,211	903

<u>Climate</u>

Elevation across the Thomas Fire ranges from sea level to 6,000 feet. Because of the variability in elevation, aspect, proximity to the coast, and general topography, annual precipitation and pattern is variable across the fire area. The maximum annual precipitation occurs near the headwaters of Matilija and Abadi Creek-Sespe Creek watersheds (~54 inches annually) with lower elevation coastal watershed of Las Sauces only accumulating approximately 16 inches annually.

Major flooding events have occurred in the Santa Ynez Mountains when a weather system dubbed the "Pineapple Express" taps into subtropical moisture from the latitudes of the Hawaiian islands. These warm and long duration storm events can cause major deluges and torrential rains leading to flooding. January 2017 had significant rainfall from such an occurrence that resulted in flood damage across Los Padres NF lands in the Santa Ynez Mountains.

B. Findings of the On-The-Ground Survey and Modeling

Assessment of the Thomas Fire involved three separate FS BAER teams. The initial BAER team assessed the slopes above the Wheeler Springs and Ojai Community in the San Antonio and Upper Ventura River HUC 6 watersheds. The second team focused on mapping soil burn severity for the whole fire. That team produced brief write-ups of field observations and watershed characterizations on each watershed that was visited. Information from these write-ups was used in some of the descriptions below.

<u>General Information:</u>

Functioning of hydrologic processes is connected to vegetation (type, density, litter and organic matter accumulation) and soil types. Fire causes impacts to several hydrologic processes including reduction in interception, transpiration, and infiltration, and increases in the rate of runoff (due to lack of litter and decreased surface roughness) and soil moisture. Removal of vegetation and changes to soil such as increases in hydrophobicity, changes in soil structure, and removal of duff and organic matter alters these processes and ultimately lead to increases in runoff, peak flows and erosion. Changes in hydrologic processes can also lead to slope instability and result in post-fire debris flows, mudflows, and other mass wasting (as described in the geology report).

Wildfires primarily affect water quality through increased sedimentation. As a result, the primary water quality constituents or characteristics affected by this fire include color, sediment, suspended material, and turbidity. Floods and debris flows can entrain large material, which can physically damage infrastructure associated with the beneficial utilization of water (e.g., water conveyance structures; hydropower structures; transportation networks). The loss of riparian shading and the sedimentation of channels by floods and debris flows may increase stream temperature. Fire-induced increases in mass wasting along with extensive vegetation mortality can result in increases in floating material – primarily in the form of large woody debris. Post-fire delivery of organic debris to stream channels can potentially decrease dissolved oxygen concentrations in streams. Fire-derived ash inputs can increase pH, alkalinity, conductivity, and nutrient flux (e.g. ammonium, nitrate, phosphate, and potassium), although these changes are generally short lived. Post-fire increases in runoff and sedimentation within the urban interface, and burned structures and equipment within the fire perimeter may also lead to increases in chemical constituents, oil/grease, and pesticides.

Table 3. Hydrologic design factors

A	Estimated Vegetative Recovery Period	3-5 years	3-5 years
B	Design Chance of Success	--%	--%
C	Equivalent Design Recurrence Interval	2 years	10 years
D	Design Storm Duration	24 hour	24 hour
E	Design Storm Magnitude	5.5-7.0 inches	8.4-11.2 inches
F	Design Flow	50 cfs/mi^2	121 cfs/mi^2
G	Estimated Reduction in Infiltration	50%	50%
H	Adjusted Design Flow	124 cfs/mi^2	239 cfs/mi^2

Changes in Vegetation and Ground Cover.
Recovery of vegetation will vary depending on SBS. In areas with low to unburned SBS, recovery will be rapid (within 1-2 years); however, for areas with higher SBS (moderate and high), recovery is estimated at 3-5 years. (See soil burn severity maps in BAER 2500-8 report.)

Lack of groundcover leaves the soil surface at risk from raindrop impact as well as reduces surface roughness and infiltration capacity. Initial erosion of ash and surface soil during the first storm events will further reduce slope roughness by filling depressions above rocks, stump holes, remaining vegetation, and pools within stream channels. Reduced surface roughness increases potential for higher peak flows and will increase the distance that eroded materials are transported. In areas with remaining overstory and low to moderate SBS, leaf litter and woody debris beneath remaining canopies will provide some soil protection and promote water infiltration. However, areas with remaining overstory are minor, as most above ground vegetation was consumed in many watersheds. Areas retaining vegetation are primarily along main stem channels. The existence of fine roots in the low and moderate severity burn areas will aid plant recovery, and suggests there still might be a seed source for natural vegetation recovery and that stumps may resprout.

Flooding Potential and Modeling
Soil burn severity has a very strong influence on flooding potential. High severity to moderate severity burned soils tend to have more water repellency post fire; however, a certain amount of water repellency is natural in pre-fire conditions as well. The increase in fire-related water repellency diminishes with lower burn severity. Field observations indicated that about 50% of the soils within the burn area exhibited hydrophobicity.

Flood potential will decrease as vegetation reestablishes, providing ground cover, increasing surface roughness, and stabilizing and improving the infiltration capacity of soils. To analyze flooding risks, specific pour points related to values at risk were selected.

Hydrologic Modeling

Modeling for post-fire flooding was conducted on selected pour points that were associated with specific VARs and/or that might be representative of watershed response in a general area. Pour points are points on the landscape through which all water upslope of the point passes through. See map in Appendix A for pour point locations.

The model designed by Rowe, Countryman, and Storey (RCS), 1949, was used to estimate post-fire increases in peak flows. Kinoshita, Hogue, and Napper, 2014 validated continued use and applicability of this model for Southern California. The model designed by RCS provides data for pre- and post-fire discharges and erosion rates in southern California watersheds. Individual rates for various subwatersheds were developed over long observation periods. The analysis in this report is based on the information in RCS tables 175, 178, 180, 182, 183, 184, 187, 198, 225, 226, and 227 (RCS, 1949).

The analysis for pre- and post- fire hydrologic response and probability of flows is based on the probability of a 2-year 24 hour storm occurring in the fire area. This is the design storm used in the development of the model that was used to estimate flows, (Rowe, Countryman, and Storey, 1949). The 2 year, 24 hour duration storm for these subwatersheds ranges from 5.5-7.0 inches across the burn based on NOAA precipitation tables (NOAA, 2014). However, although the RCS model is based on the 24 hour duration storm, the storm expected to occur within the fire burned area that could produce damaging post-fire effects is a short duration, high intensity storm (such as the storm used in the debris flow model, Geology report). Intensity within a storm and antecedent soil moisture are both spatially variable. Ultimately, when precipitation intensity is greater than infiltration rates or exceeds infiltration capacity, runoff initiates and erosion potential increases. Characteristics of the RCS design storm are listed in Table 3.

The 2-year design storm has a 50% chance of occurring in any given year, and a 97% chance of occurring in the next five years. Conversely, there is a 3% chance that the 2 year storm event will not occur in the next 5 years (during the recovery period).

The risk or probability (R) that a certain return interval storm (T) will occur over different time periods (n) was calculated by the following equation: $R= 1 – (1 -(1/T))^n$… (Chow *et al.* 1988).

Table 4. Probability of a 2 year RI Storm occurring with a given time period

Number of years	1 Year	2-Years	5-Years	10-Years
Probability	50%	75%	97%	99.9%

Table 5. Comparison of pre- and post-fire peak flow related to the 2, 5, and 10 year return interval.

	2 yr. RI Peak Flow				5 yr. RI Peak Flow				10 yr. RI Peak Flow			
Modeled Pour Point	**Pre Q (CFS)**	**Post Q (CFS)**	**Post RI Q**	**x increase**	**Pre Q (CFS)**	**Post Q (CFS)**	**Post RI Q**	**x increase**	**Pre Q (CFS)**	**Post Q (CFS)**	**Post RI Q**	**x increase**
HUC 6 watersheds (intended to be representative of trends in the north, east, west, south areas)												
Santa Paula Watershed	1,994	4,434	Q8	2.2	3,498	6,817	Q23	1.9	4,811	8,668	Q45	1.8
Lake Casitas Watershed/dam	1,957	4,139	Q8	2.1	3,423	6,363	Q20	1.9	4,719	8,163	Q40	1.7
NF Matilija Watershed	831	2,214	Q11	2.7	1,463	3,355	Q35	2.3	2,041	4,276	Q73	2.1
Matilija Watershed/Lake	2,822	7,688	Q12	2.7	4,967	11,625	Q36	2.3	6,932	14,792	Q77	2.1
Carpinteria Creek (Confluence with Gobernador)	535	1,454	Q12	2.7	936	2,182	Q32	2.3	1,294	2,748	Q62	2.1
Selected VARs (intended to be representative of areas. Does not include ALL VAR locations nor does it mean these are the only areas at risk from post fire flows.)												
Jameson Dam	679	2,012	Q15	3.0	1,191	2,994	Q44	2.5	1,654	3,776	Q83	2.3
Santa Ana Creek low water crossing	401	1,059	Q11	2.6	698	1,585	Q33	2.3	970	2,013	Q77	2.1
Matilija Creek low water crossing	2,296	6,237	Q12	2.7	4,042	9,433	Q36	2.3	5,641	12,005	Q77	2.1
Cold Springs Canyon Trail crossing	163	445	Q11	2.7	287	670	Q36	2.3	392	836	Q68	2.1
Santa Paula Trails and campgrounds	922	1,713	Q6	1.9	1,618	2,693	Q15	1.7	2,226	3,475	Q29	1.6
Middle Lion Campground	324	821	Q10	2.5	573	1,256	Q29	2.2	797	1,606	Q62	2.0
Gibraltar Reservoir (Santa Ynez inlet)***	2,754	4,101	Q4	1.5	4,886	6,738	Q10	1.4	6,740	8,900	Q18	1.3
Santa Ynez upstream of Pandola Station ***	628	1,725	Q12	2.7	1,114	2,623	Q35	2.4	1,536	3,296	Q65	2.1

Smaller Subwatersheds (intended to be representative of post-fire flows within the fire.)												
Juncal Canyon to Jameson Reservoir	357	1,053	Q15	2.9	628	1,572	Q45	2.5	870	1,979	Q84	2.3
N. Juncal Canyon to Jameson Reservoir	322	959	Q14	3.0	563	1,422	Q43	2.5	783	1,797	Q82	2.3
Coyote Creek watershed and surrounding tributaries	1,342	2,666	Q6	2.0	2,354	4,142	Q17	1.8	3,238	5,326	Q35	1.6
Willow Creek watershed and surrounding tributaries	214	414	Q6	1.9	371	636	Q16	1.7	512	824	Q31	1.6

***Estimates DO NOT include runoff above Jameson Dam. Jameson reservoir will alter timing and size of flows downstream

Table 6. Comparison of area weighted pre- and post-fire peak flow related to the 2, 5, and 10 yr RI peak flows for selected pour points.

		2 yr. RI Q		5 yr. RI Q		10 yr. RI Q	
Modeled Pour Point	**Square Miles**	**Pre Q CFS/sqmile**	**Post Q CFS/sqmile**	**Pre Q CFS/sqmile**	**Post Q CFS/sqmile**	**Pre Q CFS/sqmile**	**Post Q CFS/sqmile**
HUC 6 watersheds (representative)							
Santa Paula Watershed	38.49	52	115	91	177	125	225
Lake Casitas Watershed/dam	38.47	51	108	89	165	123	212
NF Matilija Watershed	16.07	52	138	91	209	127	266
Matilija Watershed	54.58	52	141	91	213	127	271
Carpinteria Confluence with Gobernador	13.07	41	111	72	167	99	210
Selected VARs							
Jameson Dam	13.67	50	147	87	219	121	276
Santa Ana Creek low water crossing	7.29	55	145	96	217	133	276
Matilija Creek low water crossing	44.41	52	140	91	212	127	270
Cold Springs Canyon Trail crossing	3.50	47	127	82	191	112	239
Santa Paula Trails and campgrounds	17.80	52	96	91	151	125	195
Middle Lion Campground area	9.54	34	86	60	132	84	168
Gibraltar Reservoir (Santa Ynez inlet)***	64.80	42	63	75	104	104	137
Santa Ynez upstream of Pandola Station ***	14.77	43	117	75	178	104	223
Smaller Subwatersheds							
Juncal Canyon to Jameson Reservoir	6.80	53	155	92	231	128	291
N. Juncal Canyon to Jameson Reservoir	6.87	47	140	82	207	114	261
Coyote Creek watershed and surrounding	25.90	52	103	91	160	125	206
Willow Creek watershed and surrounding	5.28	41	78	70	120	97	156

***Estimates DO NOT include runoff above Jameson Dam. Jameson reservoir will alter timing and size of flows downstream.

Overall, the primary watershed responses of the Thomas Fire are expected to include: 1) an initial flush of ash, 2) rill, gully, and mass wasting erosion in drainages and on steep slopes within the burned area, and 3) floods with increased peak flows and sediment deposition. The modeling results estimate significant increases in flow in most watersheds (as much as 2-3x normal flows). 2 year recurrence interval (RI) peak flows may resemble Q8-Q15 RI peak flows. 10 year RI peak flows may resemble Q30-Q85 RI peak flows. It is important to note that any VAR found to be at risk during the 2 year event may still be at risk during smaller events. Channel crossings, depositional fans, and floodplains have an inherent risk of flooding. Post fire modeling results are most applicable during the first year of recovery; hydrologic response will decrease in subsequent years.

Post-fire flows will be bulked with sediment and woody debris increasing the volume of runoff, which could negatively impact culverts, bridges, constructed channel ways, and other infrastructure designed to pass “normal” flows. Bulking and increased flows may cause channels to flood/divert to areas that do not usually flood. Following the 2003 Cedar Fire on the Cleveland National Forest, non-bulked results calculated using Rowe, Countryman and Storey were compared to a modified rational equation model which considered bulked flow using the U.S. Army Corps of Engineers Los Angeles district method for prediction of debris yield (2000). This comparison found that predicted bulked flows were 2.14 times larger than unbulked flows. Other studies have indicated a bulking factor of 2.5 for flows is appropriate (personal communication, WERT). A bulking factor was not included in the modeled Q listed in the assessment tables.

Specific Field Observations by Geographic Location

Pacific Frontal Watersheds

This area was visited during fieldwork for validating the BARC map and testing soil burn severity. See the Watershed Characterization write-ups for additional information. Assessment conducted by the WERT team covered these areas.

Drainages within the Pacific Frontal area are comprised of steep, rocky headwaters with confined channels, depositional fans with urban development, and drain to the ocean. Main channels within these watersheds include Cold Springs Creek, San Ysidro Canyon, Romero, Toro Canyon, Santa Monica Canyon, Carpinteria Canyon, Gobernador Creek, Rincon Creek, and a few others. Catchments have alluvial fans that spread out below the catchment outlets. Channels and fans have evidence of past debris flows, mudflows, and channel avulsion. Large quantities of stored sediment including massive boulders are pre-loading channels and may be available for transport in the event of a large runoff event. Many channels leading to the alluvial fans are transport systems, with the fans being the first and primary depositional location. This increases life, safety and infrastructure risks for the downstream urban development.

Upland vegetation was almost entirely consumed. The last fire to burn through most of the western part of the Frontal Pacific watersheds was the Coyote Fire of 1965 and the Romero Fire in 1971. Pre-fire vegetation was dense and thick accumulation of duff was likely. Where vegetation remains, it is primarily along main stem reaches. Many of the burned riparian reaches retain scorched overstory with understory cleared out. In other reaches, riparian vegetation remains dense and contains dead and down. Some riparian areas have no remaining vegetation as everything was consumed. Massive quantities of dry ravel were observed within the steep canyons and in the headwaters, filling channels and swales. Several locations have evidence of slope instability and past slope failures (scarps, debris flow deposits, etc. See Geology report). Bedrock varies in competency (erodible mudstones interbedded with more coherent sandstones) contributing to that instability. Many slopes have high rock content, especially on rocky cliffs. Soils vary in degree of water repellency based on soil type and soil burn severity. Given a similar SBS, clay rich soils tended to be less hydrophobic while rockier, sandier soils tended to exhibit strong hydrophobicity.

Watershed response in these watersheds is estimated to be high given the slopes, available sediment for transport, SBS, hydrophobicity, transport nature of the steep headwaters, and lack of vegetation. Modeling supports this interpretation, indicating an increase of approximately 2.7 times that of normal peak flows. Flooding of channels and mobilization of sediment and woody debris is likely.

<u>Santa Ynez River Drainage Area</u>
Main drainages include: Santa Ynez River, Juncal Creek, Alder Creek, Blue Canyon Creek, Escondido Creek, and Agua Caliente Creek. Assessment of this area includes the headwaters of the Santa Ynez River to the inlet of Gibraltar Reservoir. Lake Cachuma is downstream of Gibraltar Reservoir on the Santa Ynez River. North Fork Juncal and the upper headwaters of the Santa Ynez drain into Jameson Reservoir, a small reservoir used as a municipal watersource for Montecito. Almost the entire watershed draining to Jameson Reservoir burned at high and moderate SBS. Slopes have evidence of instability (scarps, large landslides, etc). Some riparian vegetation remains within the wide floodplain on the mainstem draining into the reservoir; however, most vegetation in the watershed was completely consumed. The main drainage is a wide, braided channel with large quantities of sediment stored in the channel and sizable boulders. Channels leading to the mainstem are transport channels, steep and confined. Extensive dry ravel was observed pre-loading drainages and forming debris cones along slopes. Headwaters of the reservoir range in steepness, with upper slopes forming steep cliffs and lower relief slopes forming rolling hills. Flows draining to Jameson Reservoir are estimated to increase 3 times that of normal flows. The reservoir will attenuate some of the flooding and sediment delivery to downstream reaches. This will only occur until reservoir capacity is exceeded or infrastructure fails. Suspended sediment will be flushed through to downstream reaches of the Santa Ynez, depositing on floodplains, filling in pools, and settling in Gibraltar Reservoir and Lake Cachuma.

The area that burned outside of the Jameson Reservoir subwatershed to the confluence with Agua Caliente will still contribute large quantities of sediment to the Santa Ynez River. Most of this area burned at moderate to high SBS and has evidence of active slope failures in average years (mudslides, old debris flow deposits). The channel within this reach was largely unburned or retained large wood and overstory despite burning. The channel is a wide, braided channel with multiple flow paths and riparian vegetation. Bedload includes boulder sized material.

The Santa Ynez below the confluence of Agua Caliente to the Gibraltar inlet is unburned and has similar characteristics (wide, braided channel with intact riparian vegetation connected to the floodplain). Gibraltar has lost significant capacity overtime due to historic fires. Modeling of these areas was segmented due to the influence of the Jameson Reservoir. Modeling for post-fire flows for the Santa Ynez above the confluence with Agua Caliente indicated an increase of 2.7 times that of normal flows (excluding any runoff from Jameson subwatershed). Modeling for post-fire runoff into Gibraltar from the Santa Ynez (excluding runoff from the Jameson subwatershed) indicated an increase of 1.5 times that of normal flows. In actuality, both of these modeled flows will be higher as runoff from Jameson Reservoir will contribute and nearly 85% of the HUC 6 Juncal Canyon reservoir burned at moderate to high SBS. As stated, it is estimated that suspended sediment will flush through the system impacting capacity in all the downstream reservoirs.

Matilija Canyon

Main channels within the Matilija HUC 6 watershed include North Fork Matilija, Matilija Creek, Murrietta Canyon, and Old Man Canyon. The majority of the watershed is comprised of the Matilija Wilderness and remains roadless. Matilija Reservoir is located near the watershed outlet. The reservoir no longer functions as a water source and is in the process of being decommissioned. The reservoir has been filling in over time and has little capacity remaining, evident by the large sediment wedge accumulating at inlets and associated vegetation. The spillway has been notched to allow flows to pass. Matilija Creek is a wide, braided channel system with very large boulders in the bedload. There is evidence of past debris flows (dated younger than 1969 as that was when debris flows damaged a USGS gaging station installed around 1949) that mobilized car-sized boulders and formed huge debris flow lobes in the channel. There are multiple historic and abandoned channels. The bedload and slopes failures have caused the channel to migrate across the canyon bottom multiple times. Some riparian vegetation remains along the channel; however, most slopes are completely bare and all vegetation has been consumed. Headwaters are very steep and dry ravel is common. SBS within the watershed is almost entirely moderate and high SBS (~80%) with very little low/unburned. Flows were modeled to increase 2.7 times that of normal pre-fire flows. There are roads and inholdings along the canyon bottom that are at risk from debris flows, flooding, mudflows, slope failures, etc. The main access road has rockfall and slope failures in pre-fire conditions. These issues will only be exacerbated. FS road 5N13 has a road segment within the floodplain and a LWC that crosses Matilija Creek. This crossing could be exceptionally dangerous in high flows. There are communities downstream of the Matilija reservoir. If infrastructure fails, these homes could be impacted. More detailed reconnaissance is required.

North Fork Matilija Creek Watershed

Main channels within the North Fork Matilija watershed include North Fork Matilija, Bear Creek, and Cannon Creek. The majority of the creek in this watershed is confined and primarily a transport system. In places, reaches must make several tight turns though coherent sandstone bedrock. These are areas where stream power is not only very intense (due to confinement) but also a location where material could be hung up as the channel must make several tight turns. HWY 33 is adjacent to the creek in this area and near the lower reaches of the watershed. There appears to be a history of road and slope issues that will be made worse by post-fire effects. An FS campground and station (Wheeler area) are located on the North Fork Matilija. An assessment of this area was conducted in the first BAER report. Additionally there are inholdings in the watershed at the base of slopes that could be at risk from post-fire impacts. Further investigation is recommended. Riparian vegetation is mostly intact along the mainstem;

however, the majority of the watershed burned at moderate to high SBS (~76%). Flows in the watershed are expected to increase 2.7 times that of normal pre-fire flows. Evidence of past slope failures and active dry ravel in the steep headwaters will contribute to risks of greater bedload in post-fire runoff events.

Coyote Creek Area (Lake Casitas Reservoir)

Main stream channels include Santa Ana, Coyote and Willow creeks, which all drain to Lake Casitas Reservoir. Lake Casitas is a municipal water source. Slopes in the Santa Ana and Coyote creek headwaters have steep headwaters with lower gradient slopes below. Upper slopes are dominated by Coldwater Sandstone and create exposed rocky outcrops. Lower gradient slopes are comprised of shales, and form low relief hills with little rock cover and make up much of the watershed. Although relief on many slopes is lower, soil/geology type is easily eroded. The shale deposits are erodible and will be transported easily. Dry ravel was observed throughout the watershed, pre-loading channels. Drainages have evidence of various types of slope failure and rock fall related to the shale. Evidence of slumps, earthflows, landslides, dry ravel, debris flows, and mudflows are visible throughout the watershed. Earthflows are common in this formation and throughout this watershed.

Portions of this watershed (Willow Creek area and around the reservoir) were either unburned or had mosaic unburned-low-moderate SBS patterns. The Coyote Creek and Santa Ana subwatersheds had mostly moderate to high SBS. Riparian areas retained vegetation along the mainstem channels and around the reservoir.

Lake Casitas will attenuate peak flows and sediment transport of larger material. Suspended sediment will likely be flushed through the system as well as impact capacity within the lake. The Santa Ana drainage has debris flow deposits lower in the catchment, most likely originating from the steep headwaters. Modeling indicates an increase in post-fire peak flows of 2.6 times that of normal in Santa Ana area and 2.1 that of normal for the overall drainage to Lake Casitas. There is a low-water crossing on Santa Ana Creek (used for pour point delineation) that is the main ingress/egress for the northeast part of the watershed. Increased flows pose a life and safety risk at the low-water crossing.

Overall, Coyote Creek watershed will likely experience a pronounced increase in sediment and higher peak flows that will be somewhat attenuated in Lake Casitas. Houses, roads and other infrastructure in and near creeks upstream of the lake are at increased risk. There is a need for a detailed assessment of the communities and inholdings in the area.

Santa Paula Creek Watershed

Main drainages within this watershed include: Santa Paula, East Fork Santa Paula, Bear Canyon and Sisar Creeks. Topography is unstable with many small slumps and scarps present. The last large fires to occur in this watershed was the Ferndale Fire in 1985. Mainstem channels are braided, contain multiple flow paths, have large boulders, and large amounts of stored bedload. Much of the basin bottom is mapped as alluvial fan and stream gravel deposits. The creek has a small dam before Santa Paula and is then channelized as it goes through the community of Santa Paula into the Santa Clara River. Riparian vegetation was found to be intact with scorched oaks and sycamores. Dry ravel was present throughout the area, charging channels and drainages with debris cones. The headwaters burned 51% with moderate to high SBS exhibiting some scorched duff with leaf structure under gravel pavement or single grain sand. Water repellency was present, generally within an inch below the surface with various thickness, patchy, with little to no repellency between the shrub canopies. Modeling has estimated flows to increase 2.2 times that of normal flows. Overall, Santa Paula Creek will likely experience a pronounced increase in sediment and higher peak flows. Houses, roads and other infrastructure in and near the creek are at increased risk and should be assessed in detail for post-fire risks.

Sespe Creek Drainage Area

Sespe Creek is a very large drainage system with a wide sandy braided channel. Multiple HUC 6s burned in the Thomas Fire drain to the mainstem; however, most of the acreage is distributed across many small drainages, across the ridge tops, and in a mosaic pattern. The area draining to Sespe Creek that may experience the highest amount of post-fire impact is the Tule Creek HUC 6 watershed area. This includes the drainages of Lion Canyon, Rose Valley, and Howard Creek. These are the largest areas of concentrated burn and most moderate to high SBS within the Sespe Creek drainage system. Headwaters are steep with depositional fans at the base, which exhibit evidence of large historic depositional events (mudflows, debris flows, flooding, etc). Areas near the top of the fans and up into canyons have large boulders in the deposits and channels. Dry ravel is observed throughout the burn area. Riparian vegetation was scotched with understory consumed but larger trees and overstory remain. There are areas of unburned slopes within the headwaters; however, many of these areas were very rocky cliffs that had little vegetation in the pre-fire condition. All three main drainages have downstream VARs that are located on fans and floodplains: Rancho Grande-inholding, FS Middle Lion CG, and FS Rose Valley CG.

Timber and Boulder Creek watersheds burned at lower SBS and did not have any specific FS VARs. A detailed analysis was not conducted for this area.

1. Consequences of the fire on values at risk

The 2500-8 has a list of VARs evaluated in the assessment. Potential post-fire threats are listed as well as risk determination and treatment recommendation. Only Values at Risk requiring treatment are discussed in detail in this assessment narrative.

Probability of Damage or Loss	**Magnitude of Consequences**		
	Major	Moderate	Minor
	RISK		
Very Likely	**Very High**	**Very High**	**Low**
Likely	**Very High**	**High**	**Low**
Possible	**High**	**Intermediate**	**Low**
Unlikely	**Intermediate**	**Low**	**Very Low**

All recreation trails within or below the burn area:

Maps and some field review were used to conduct the assessment on trails in the backcountry and front country. Many trails in the burn area or downstream of the burn area are located in or

adjacent to channels and/or areas exhibiting unstable slopes. All trails within and downstream of the burn perimeter are at risk from increased flows, sediment laden flows, and mudflows (see geology report for risks of rockfall, debris flows and other mass wasting). Trails have several channel crossings that could be safety concerns during high flow events. Impacts could be loss of drainage control leading to loss of trail and impacts to natural resources, complete loss of trail, and risks to life and safety.
Probability of post-fire impacts: Very Likely-Likely
Magnitude of consequences: Major-Moderate
Risk: Very High-High
Determination: BAER treatments are recommended. See 2500-8 for treatments.

All dispersed campgrounds within or below the burn area:
Maps, aerial reconnaissance and modeling were used to conduct the assessment on backcounty dispersed campgrounds. Many of the backcountry campsites are located near stream channels and/or basin bottoms (flat terrain conducive to setting up tents). Observed slope failures in the headwaters and the debris flow modeling (described in the Geology Report) indicate several campgrounds are at risk from mass wasting. Modeling conducted for the Santa Paula trail include indicated an increase in peak flows, 2 year peak runoff will resemble 10 year peak runoff, and 5 year peak runoff will resemble 15 year peak runoff. Campgrounds or dispersed camping located in low-lying areas, on depositional fans, near small basin catchments, or on floodplains are at risk from post-fire flooding, slope failures, and sediment laden flows. Impacts are risks to life and safety.
Probability of post-fire impacts: Very Likely
Magnitude of consequences: Major
Risk: Very High
Determination: BAER treatments are recommended. See 2500-8 for treatments.

Developed campgrounds within or below the burn area:
Middle Lion Campground: Campground is located near the channel on an incised depositional fan at a catchment outlet. The fan has a series of abandoned historic channels and evidence of historic large episodic depositional events. Fan topography is directing channel location to flow near the campground. Modeling of the change in peak flows indicates an increase in the 2year peak flow to resemble 10 year flow and 5 year flows to resemble 29 year flows. Impacts to the campground could be flooding and burial by sediment laden flows, minor loss of campground infrastructure, and risks to life and safety.
Probability of post-fire impacts: Likely
Magnitude of consequences: Major
Risk: Very High
Determination: BAER treatments are recommended. See 2500-8 for treatments.

Rose Valley Campground: Campground is located near the channel at the base of a confluence of several small, steep catchments with multiple deposits from historic mass wasting events. The channel bottom has several abandoned channels amidst the historic debris flow and mudflow deposits. The current channel location is adjacent to the campground and confined by a debris flow deposit. Channel location could migrate in a large event. One catchment is directly aligned with the campground location and in most years, drains through the campground. There is a low

water crossing at the entrance of the campground. Impacts to the campground could be flooding and burial by a mass wasting event or sediment laden flows, minor loss of campground infrastructure, and risks to life and safety.
Probability of post-fire impacts: Likely
Magnitude of consequences: Major
Risk: Very High
Determination: BAER treatments are recommended. See 2500-8 for treatments.

Middle Santa Ynez Campground: Campground is located on the Santa Ynez River floodplain, which is a wide, braided channel system with a wide, vegetated floodplain. The campground is at risk from flooding and sediment laden flows. Impacts include minor impacts to forest service infrastructure and risks to life and safety.
Probability of post-fire impacts: Possible
Magnitude of consequences: Major
Risk: High
Determination: BAER treatments are recommended. See 2500-8 for treatments.

All FS roads within the burn area
Roads within the burn area are subject to increased post-fire runoff (see modeling), sediment laden flows, and mass wasting (geology report). Multiple roads (especially 5N13, 4N05, 5N12) used as main access for the Forest have sections that are at risk of complete road loss and/or major washout. Crossings and culverts are at risk of plugging, diversion, and potential road failure due to increases in peak flow and sediment laden flows. While many of these crossings and culverts control drainage in most years, flows in the burn area are expected to increase 1.5-3 times the size of pre-fire flows. Slopes above these roads are inherently unstable but increases in runoff, lack of vegetation, and changes in soil properties will exacerbate the instability, making these roads subject to failure. Slope failure, sediment delivery, and mobilization of woody debris increase the risk of road culverts failing. Some road segments have diversion potential that could lead to a cascading culvert failure and complete road prism loss. Diversion of stream crossings and plugging of culverts poses a risk to FS infrastructure, water quality, and natural resources as well as life and safety.
Probability of post-fire impacts: Very Likely-Likely
Magnitude of consequences: Major
Risk: Very High
Determination: BAER treatments are recommended. See 2500-8 for treatments.

Low-water crossing throughout the burn area will experience increased peak flows and sediment laden flows. Crossings pose a risk to life and safety if users are attempting to cross during runoff events.
Roads of specific concern are:

- 5N15—one crossing on Santa Ynez River
    - Very wide concrete ford that crosses the Santa Ynez Road. Additionally, this road has multiple locations at risk from slope failure and an entire segment is at risk of erosion by the Santa Ynez River. Santa Ynez River peak flow will increase 2.7-3 times that of normal flows.
- 5N13—two crossings on Santa Ynez River

    - One below the Jameson Reservoir and one above. Santa Ynez River is a sizable channel moving large bedload. It is expected to have increases in runoff 3 times that of normal flows.
- 5N13—one crossing on Matilija Creek
    - Road segment leading to low water crossing is located on a combination of flood and debris flow deposits. Area has a history of debris flows with car-sized boulders in the channel. Floodplain is wide and bedload ranges from cobbles to car-sized boulders. Flows are expected to increase 2.7 times that of normal flows.
- 6N13—one crossing near Rancho Grande
    - Road segment leading from the east is at risk of washing out. There are incised channels on both sides of the road draining to the low water crossing. The low water crossing is at the base of a fan and the channel is subject to avulsion in a post-fire event triggering mass wasting.
- 5N42—one crossing on Rose Valley Campground access road
    - Low-water crossings on the access road to Rose Valley campground may be unsafe during high flows. Campground can be closed with a gate but low water crossings are located outside of gated area. Flows in the area are estimated to increase 2.5 times that of normal flows.

Probability of post-fire impacts: Very Likely
Magnitude of consequences: Major
Risk: Very High
Determination: BAER treatments are recommended. See 2500-8 for treatments.

Forest Service Infrastructure:
Pandola Fire Station is located up the Agua Caliente drainage out of the flooding risk from the Santa Ynez River. Potential impacts to the station's infrastructure exist from the slopes above. It is unlikely that the station would be at risk from mudflows off the adjacent fan as the station is set off to the side. A small outbuilding and native surface road leading up the slope are at risk of mudflows and increased runoff from the slopes above. An ephemeral channel has been ditched with a berm parallel to the access road. The intent of the berm was to redirect flows out onto the fan away from the outbuilding. It is possible that the berm will be overwhelmed or that flows could be directed down the adjacent road, washing out the road or flooding/impacting the outbuilding. Impacts would be to FS infrastructure and possibly to life and safety if someone is inside the building.
Probability of post-fire impacts: Unlikely-Possible
Magnitude of consequences: Minor to Moderate
Risk: Very Low to Intermediate
Determination: BAER treatments are recommended. See 2500-8 for treatments.

<u>Non-FS owned Values At Risk Located with the Forest Service official boundary.</u>
Several non-FS owned VARs are located within the Forest Service official boundary. These sites will be addressed through interagency coordination with various agencies and the State's WERT team. Some of the VARs are listed below. This is not a complete list of non-FS owned VARs. A detailed assessment of these VARs should be completed by agencies that can assist private landowners or the agency responsible for the infrastructure.

Non-FS Infrastructure: Reservoirs

Jameson Reservoir is located within the Juncal Creek watershed. The entire watershed draining to the reservoir burned (85% at mod to high SBS), including most of the riparian vegetation. Modeled runoff indicates runoff will be significantly increased. The Santa Ynez above the dam is a wide, braided channel with cobble to boulder sized bedload. The reservoir will affect bedload transport. Suspended bedload will be transported through the system to the channel below but larger boulders and cobbles will accumulate either in the reservoir or in the channel above. The dam will attenuate floods and bedload transport within the Santa Ynez River until the reservoir's capacity is exceeded or the dam fails. Impacts to Jameson Reservoir include impacts to water quality and reservoir capacity.

Gibraltar Reservoir is located within the Santa Ynez River watershed. Riparian vegetation is intact between the fire perimeter and the Santa Ynez River inlet to the reservoir. The riverbed is a heavily vegetated, braided channel system within a wide floodplain. Bedload consists of cobbles and boulders. The reservoir has limited capacity as there has been infilling over time from other fires. Post-fire generated boulders and cobbles above the Jameson Reservoir will be deposited upstream of the Jameson dam; however, suspended sediment from the fire burn area will still be transported downstream. Given the gradient of the channel, larger bedload initiating from the remainder of the burn area (outside the Jameson reservoir catchment), is unlikely to make it to the Gibraltar Reservoir. Suspended sediment is likely to be deposited in the reservoir, negatively impacting capacity. Should the Jameson dam fail, peak flows and sediment delivery in the Santa Ynez River will increase significantly as the reservoir will no longer attenuate flows or dam sediment. Impacts to Gibraltar Reservoir include impacts to water quality and reservoir capacity.

Lake Cachuma is located downstream of Gibraltar Reservoir on the Santa Ynez River. Although the reservoir is located several miles downstream, it is anticipated that suspended sediment will reach the reservoir. Suspended sediment will impact water quality and reservoir capacity.

Matilija Reservoir is located within the Matilija HUC 6 watershed. The reservoir has been notched in an attempt to slowly decommission the dam, as the reservoir has lost capacity over time. There is a wedge of accumulated sediment above the dam and the channel gradient flattens. Effects of the reservoir on channel grade and the widening of the floodplain will result in large bedload accumulating upstream of the dam further filling it in. In high flows, suspended sediment will be transported downstream. In lower flows, suspended sediment will settle in the reservoir. The reservoir has very little ability to attenuate flooding as the dam is notched and the water level is at the notched elevation. Failure of the dam could result in risks to life and safety of downstream communities.

Non-FS Infrastructure: Utilities

There are several utilities on FS lands within the fire burned perimeter. Power poles and buried lines could be at risk from flooding, mudflows, erosion, and increased peak flows if they are located in low-lying areas, buried under channels, or located in floodplains. Increased peak flows have the ability to mobilize larger bedload and increase erosion, which could expose buried lines. Flooding and mudflows could damage above-ground utilities. (See geology report for impacts from slope failure and debris flows.) Impacts to utilities could result in risks to life and safety as well as property.

Non-FS Infrastructure: Highways
(See geology report for impacts from debris flows, slope failures, and rockfall.)
Several highways are located within and downstream of the burn area, including highways 33, 150, 192, 144, 101, and 126. These are heavily used roads that have multiple stream crossings that drain large acreages of burned area. Post-fire flooding, sediment laden flows, and mudflows will impact the life and safety of users as well as infrastructure. The FS did not conduct a detailed analysis of these VARs but did engage with the State WERT and other agencies to discuss risks. The State WERT team took the lead on evaluating risks for these VARs. The following are field notes and observations that were made during FS fieldwork during the evaluation of other VARs.

Highway 33 is at risk of road failure. Some highway segments located within the burn area are adjacent to stream channels, have crossings, and/or are located on steep slopes. For example, the highway in North Fork Matilija is located in a narrow canyon directly adjacent to the stream channel. There is potential for debris and boulder jams to form, and in combination with increased flows, may cause scouring of the road prism and/or flooding.

Highways 192, 144, and 101 are at risk from flooding, mudflows, and flows carrying woody debris/rock that could lead to plugging of culverts/crossings. Additionally, the highways are located on alluvial fans that have potential to migrate channel location during flooding or mass wasting events. Should plugging of crossings occur or flooding overwhelm the crossings, the surrounding urban areas would be negatively impacted.

HWY 150 has similar risks from nearby slopes as the other highways. The highway has culverts with evidence of past plugging, nearby unstable slopes, and stream crossings draining areas estimated to have increased flows (2 to 2.6x) and levels of sediment.

HWY 126 has several crossings but the upstream area burned at lower SBS than the other highways; however, the headwaters draining to the crossings has transportable material and Santa Paula watershed is estimated to have peak flows increasing approximately 2x normal flows.

Non-FS Infrastructure: Private Lands and roads
Multiple non-FS roads are within and downstream of the burn area. Many have evidence of historic blowouts or past failures. Of great concern are low water crossings that are used as the only ingress/egress for communities. Given the increase in sediment, slope instability, and increase in post fire flows, there is a risk to life, safety and infrastructure associated with many of these roads.

Non-Forest Service Property and inholdings
The 2500-8 VAR spreadsheet has a list of inholding that were noted from the air and maps to be within or downstream of the burn area. THIS IS NOT A COMPLETE LIST OF ALL VALUES AT RISK ON PRIVATE LAND that may be impacted by the post-fire environment. All non-FS

private inholdings within, near, or downstream of the burn area should contact the NRCS or State WERT team for a detailed assessment of their property and potential post-fire risks that may exist.
Below are field observations for some of the private inholdings:

- Matilija Canyon inholdings: See section on Matilija Canyon Watershed. Homes are located on the floodplains and adjacent to steep slopes. The watershed is expected to have a significant watershed response resulting in mudflows, debris flows, and flooding. There is one road used for ingress/egress that has had pre-fire rock fall and slope failures. It is strongly suggested that a detailed analysis of this area be conducted.
- Wheeler Springs area: See section on North Fork Matilija Canyon Watershed. There are homes located in the floodplains and adjacent to steep slopes. The watershed is anticipated to have a significant watershed response including debris flows, mudflows, and flooding. Roads (HWY 33) may washout, restricting ingress/egress. It is strongly suggested that a detailed analysis of this area be conducted.
- Santa Ana community up Santa Ana Valley: See section on Coyote Creek Watershed. There are homes located in the floodplain and on debris flow deposits in the Santa Ana Valley. There is a low water crossing and multiple culverts that will experience increased runoff and sediment transport. It is strongly suggested that a detailed analysis of this area be conducted.
- Rancho Grande: This is a private inholding located in the channel at the confluence of over 4 drainages. Infrastructure is located in the bottom of the basin and at the outlet of a catchment/top of an alluvial fan. This location has potential to experience flooding, mudflows, and debris flows. It is strongly suggested that a detailed analysis of this area be conducted.
- Faser Cold Springs Ranch: Private inholding on north end of the fire. The main access road is at the base of steep, burned slope (some unburned acreage as well). Infrastructure is located across the road from the burned slope on the alluvial fan. There is potential for slope failures to block access and possibly impact infrastructure. It is strongly suggested that a detailed analysis of this area be conducted.

II. Emergency Determination – See VAR spreadsheet for a detailed risk assessment.

Emergency exists. BAER treatments are recommended.

III. Treatments to Mitigate the Emergency

See 2500-8 spreadsheet of VARs for treatments. Costs for various treatments are described in 2500-8 and other specialist reports.
Signage locations for low-water crossings are listed in the VAR field observations (this report in *Consequences of the fire on VARs*.)

IV. Recommendations –

All recreation trails within or below the burn area:

Closure of the trails is recommended until hydrologic processes have recovered to the point that flooding and mudflow risks are diminished. Trails should be stormproofed to prevent impacts to water quality.

All dispersed campgrounds within or below the burn area:
Closure of the campgrounds is recommended until hydrologic processes have recovered to the point that flooding and mudflow risks are diminished.

Developed campgrounds within or below the burn area:
Middle Lion Campground: Closure of the campgrounds is recommended until hydrologic processes have recovered to the point that flooding and mudflow risks are diminished.

Rose Valley Campground: Closure of the campgrounds is recommended until hydrologic processes have recovered to the point that flooding and mudflow risks are diminished.

Middle Santa Ynez Campground: Closure of the campgrounds is recommended until hydrologic processes have recovered to the point that flooding and mudflow risks are diminished.

All FS roads within the burn area
Closure of the roads is recommended until hydrologic processes have recovered to the point that flooding and mudflow risks are diminished. Road stormproofing is recommended to protect water quality and infrastructure. Low-water crossing throughout the burn area will experience increased peak flows and sediment laden flows. It is recommended that warning signs be placed at six low water crossings in the burn area.

Forest Service Infrastructure:
Closure of the Pandola Fire Station is recommended until hydrologic processes have recovered to the point that flooding and mudflow risks are diminished. (Access roads are dangerous.) It is also recommended that the road behind the station is waterbarred and sandbags be placed around the base of the shed.

Non-FS owned Values At Risk Located with the Forest Service official boundary.
Interagency coordination is recommended for all non-FS owned VARs.

V. References –

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